CHAPTER

A SCREENING QUESTIONNAIRE FOR VOICE PROBLEMS AFTER TREATMENT OF EARLY GLOTTIC CANCER

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ABSTRACT

Purpose: After treatment for early glottic cancer, a considerable number of patients end up with voice problems interfering with daily life activities. A 5-item screening questionnaire was designed for detection of voice impairment. The purpose of this study is to assess psychometric properties of this questionnaire in clinical practice.

Methods and Materials: The questionnaire was completed by 110 controls without voice complaints and 177 patients after radiotherapy or laser surgery for early glottic cancer.

Results: Based on normative data of the controls, a score of 5 or less on at least 1 of the 5 questions was considered to state overall voice impairment. Reliability of the questionnaire proved to be good. Voice impairment was reported in 44% of the patients treated with radiotherapy vs. 29% of the patients treated with endoscopic laser surgery.

Conclusions: The questionnaire proved to be a reliable, valid, and feasible method to detect voice impairment in daily life. The questionnaire is easy to fill in, and interpretation is straightforward. It is useful for both radiation oncologists and otorhinolaryngologists in their follow-up of patients treated for early glottic cancer.
INTRODUCTION

Because the aim of cancer treatment is directed primarily at achieving cure and secondarily at preventing or restoring major functional deficits, the mainstream of research has not been focused on the outcome of early glottic cancer treatment. Early glottic cancer has excellent cure rates, irrespective of the treatment modality, of which radiotherapy and endoscopic laser surgery are the most widely used, and the voice outcome is often said to be “functionally” normal, usually without a definition of functionality being given. Local control rates range from 82% to 96% after endoscopic laser surgery to 67% to 96% after radiotherapy, and rates of ultimate preservation of the larynx range from 93% to 100% after initial endoscopic laser surgery to 85% to 97% after initial radiotherapy. Those few studies that did define functionality unfortunately often used different definitions and described an abnormal voice outcome ranging from 14% to 92% after radiotherapy and 17% to 61% after laser surgery. Comparative studies show either no difference between both treatment modalities or a slightly better voice quality after radiotherapy.

The most important question, however, is whether deteriorated voice quality affects the ability to communicate and thereby results in limitations in social participation. Such studies on voice problems in daily life or communicative suitability of patients after their treatment for laryngeal cancer are scarce and the results contradictory.

Smith et al. reported that patients primarily treated for early glottic cancer either with endoscopic excision or radiotherapy were satisfied with their speech and understandability, which did not impede daily life activities. Other studies focusing more on voice than on speech revealed more voice-related problems in daily life. Verdonck-de Leeuw et al. found that only 55% of the patients treated with radiotherapy regained normal voice quality, whereas in 45% of the patients, voice quality remained abnormal with negative consequences in daily life. Van der Torn et al. showed that communicative suitability of patients after radiotherapy as judged by “naïve” listeners improved but did not approach normal communicative suitability. They also found that with increasing vocal demand, the communicative suitability decreases. Stoeckli et al. reported an increased difficulty in communication (hoarseness, trouble talking to other persons or on the telephone) for patients after both endoscopic laser surgery and radiotherapy, without significant differences between both treatment modalities. Jepsen et al. used the Voice Handicap Index (VHI) to compare consequences of voice outcome after treatment for laryngeal cancer. They suggested greater voice impairment (mean VHI = 42.2) by patients treated for glottic laryngeal cancer than by patients treated for supraglottic laryngeal cancer (mean VHI = 27.2). Patients with combination therapy of laser surgery and radiotherapy did worse (mean VHI = 34.9) than patients treated with laser surgery alone (mean VHI =
22.5). Peeters et al. compared voice problems in daily life as judged by the patients themselves (VHI) 2 years after radiotherapy or laser surgery for T1aN0M0 glottic carcinoma. They found a deviant VHI score in 40% of the patients treated with laser surgery vs. 58% of the patients treated with radiotherapy.

It can be concluded from these studies that, despite the generally held belief to the contrary, a considerable number of patients end up with deteriorated voice quality after treatment for early glottic cancer, with an impact on daily life function.

Not only can a deviant voice quality lead to limitations in social life, but it can also be an early sign of tumor recurrence. A standardized easy and brief questionnaire to detect voice impairment or deterioration is therefore mandatory. In earlier studies, a 12-item questionnaire on voice problems was designed and validated: High correlations were found with perceptual voice quality evaluation by trained raters and vocal function. Though very useful in a study setting, this 12-item questionnaire was considered too extensive for routine use in a busy clinic. Therefore, a shorter and more robust questionnaire was developed. The Dutch Cooperative Head and Neck Oncology Group recommends this 5-item questionnaire for the assessment of the voice on a regular basis after treatment of glottic cancer.

The purpose of the present study is to assess psychometric properties and value of this brief questionnaire to be used in daily clinical practice, in terms of internal consistency, reliability, predictive validity, and normative data.

PATIENTS AND METHODS

Patient group

During a 1-year period, 177 patients visiting the outpatient clinic for their follow-up visit after initial radiotherapy or endoscopic laser surgery for early glottic cancer were requested to participate. All patients were treated 6–120 months before inclusion. At the time of inclusion, there were no indications of tumor recurrence or other organic laryngeal disorders. Tumor classification ranged from severe dysplasia/carcinoma in situ to squamous cell glottic carcinoma stage T1N0M0 or T2N0M0 (according to the UICC staging system). An overview of patient data is given in Table 1.

Of the 126 patients treated with radiotherapy (9 females, 117 males), 2 (1.6%) were diagnosed with severe dysplasia/carcinoma in situ, 52 (41.3%) with T1aN0M0, 32 (25.4%) with T1bN0M0, and 40 (31.7%) with T2N0M0 glottic carcinoma. All patients were locally irradiated with the Varian CLINAC 2300, a linear 6-MV accelerator (Varian Medical Systems Inc., Palo Alto, CA, USA). The total radiation was 57.5 to 60.0 Gy in case of T1a and T1b tumors (2.5 Gy per fraction, 5 times a week), whereas T2 tumors were generally ir-
radiated with an accelerated schedule to a total dose of 70 Gy (2 Gy per fraction, 6 times a week). All T1 patients were treated with two opposing lateral fields, generally, with a standard field size of 6 x 6 cm, using 6-MV photons. In case of a T2 tumor with supraglottic extension beyond the false cords and/or subglottic extension < 1 cm, the radiation portals were extended to levels II to IV on both sides and/or the paratracheal lymph node areas, respectively. Mean posttreatment time was 46 months (range, 6 – 135 months). The mean age of the patients treated with radiotherapy at inclusion was 66 years (range, 39 – 80 years).

Of the 51 patients (6 females, 45 males) primarily treated by endoscopic laser surgery, 25 (49%) were diagnosed with severe dysplasia/carcinoma in situ and 23 with T1 tumors (18 T1aN0M0 [35.3%], 5 with T1bN0M0 [9.8%]), and 3 (5.9%) with T2N0M0. All patients had been selected for endoscopic laser surgery by means of videolaryngostroboscopic evaluation, using the presence of mucosal undulation as an indication for superficial tumor spread. A Sharplan-CO2-laser (with ACU-spot micromanipulator; Sharplan Laser Industries, Tel Aviv, Israel) in a super-pulse mode was used. Patients in the laser surgery group had a mean posttreatment time of 24 months (range, 6 to 127 months). The mean age of the patients treated with endoscopic laser surgery at the time of inclusion was 66 years (range, 40 – 81 years).

<table>
<thead>
<tr>
<th>Table 1. Overview of patient data on treatment modality and tumor stage</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Severe dysplasia/ Carcinoma in situ</td>
</tr>
<tr>
<td>T1aN0M0</td>
</tr>
<tr>
<td>T1bN0M0</td>
</tr>
<tr>
<td>T2N0M0</td>
</tr>
</tbody>
</table>

Control group

To collect normative data on the questionnaire, 110 persons without apparent voice complaints were asked to complete the questionnaire. The control group consisted of 55 males and 55 females; 85 persons were current smokers. Subjects were matched for age group of 40 to 80 years with a mean of 61 years.

Questionnaire

All 177 patients and 110 controls were asked to fill out a screening questionnaire concerning voice problems in daily life. The questionnaire is composed of 5 questions on a 10-point scale covering vocal abilities and social situations. An overview is given in Appendix 1.
**Statistical analyses**

Cronbach’s alpha was calculated to determine internal consistency of the questionnaire. Spearman correlation coefficients were calculated to determine interrelations between the 5 items of the questionnaire.

Normative criterion values were set based on the 95% central range (2.5% at each end of the distribution) for each separate question of the control group.

To investigate test-retest reliability of the questionnaire, all 177 patients were asked by mail to fill in the same questionnaire again after a period of time. The mean time between the completion of the two questionnaires was 5.3 months (range, 1–10 months, median: 5 months). During this period, none of these patients underwent any intervening medical or surgical treatment. Two extra questions were attached to exclude overall health problems and recent voice problems that could cause voice changes and thereby influence the results. To evaluate each item’s test-retest reliability, intraclass correlation coefficients were computed.

To test predictive validity of the questionnaire in clinical practice, the number of patients with self-reported voice impairment either treated by radiotherapy or laser surgery for early glottic cancer was determined. Voice impairment was defined by the criterion value obtained from the control group as described above. To test whether the screening questionnaire could differentiate between controls and patients, Mann-Whitney tests were carried out. Next, the ratings of the radiotherapy group and the laser group were compared to test whether a difference in voice impairment could be detected between the two treatment modalities. For this purpose, chi-square and Mann-Whitney tests were carried out.

In the patient group, Spearman correlation coefficients were calculated to determine the relation between voice impairment, age, tumor stage, and posttreatment time. In the control group, Spearman correlations were determined between score per question, gender, and current smoking habit.

**RESULTS**

**Internal consistency and interrelations**

The internal consistency of the screening questionnaire as a whole was assessed by Cronbach’s alpha and seemed to be 0.88 for the control group and 0.89 for the patient group. Interrelations between the five items were assessed by Spearman correlation coefficient. Spearman correlation coefficients between the five items ranged from 0.59 to 0.73 for the patient and control group as a whole (Table 2). Because of the moderate Spearman
correlation coefficients, the five items on the screening questionnaire were regarded separately; a composite score was not calculated.

Table 2. Interrelations (Spearman correlation coefficients) of the five items on the questionnaire for the patient and control group as a whole

<table>
<thead>
<tr>
<th>Item 1</th>
<th>Item 2</th>
<th>Item 3</th>
<th>Item 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 2</td>
<td>0.616</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Item 3</td>
<td>0.590</td>
<td>0.691</td>
<td>1.000</td>
</tr>
<tr>
<td>Item 4</td>
<td>0.639</td>
<td>0.671</td>
<td>0.640</td>
</tr>
<tr>
<td>Item 5</td>
<td>0.601</td>
<td>0.727</td>
<td>0.699</td>
</tr>
</tbody>
</table>

Normative data

Based on the control data, normative data were determined. The 95% central range was assessed for each of the five questions; results are shown in Table 3. For each separate question, a score less than the 2.5th centile was regarded as signifying voice impairment. To facilitate the interpretation of the questionnaire in clinical practice, one criterion value valid for all five questions was determined. Based upon these 2.5th centiles from the separate questions and the 10-point grading scale commonly used in the educational system, in which 5 or less is evaluated as insufficient and 6 or more as sufficient, the criterion value for all five questions was set at the score of 5. This means that patients scoring 5 or less on at least one of the five questions were considered to have overall voice impairment.

Table 3. Results of the 95% central range for each individual question based on the control group

<table>
<thead>
<tr>
<th>Question</th>
<th>2.5th percentile</th>
<th>97.5th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does your voice sounds deviant (e.g. breathy or rough)?</td>
<td>5.00</td>
<td>10.00</td>
</tr>
<tr>
<td>2. Do you encounter problems holding conversation due to your voice?</td>
<td>5.78</td>
<td>10.00</td>
</tr>
<tr>
<td>3. Do you encounter problems making a telephone call due to your voice?</td>
<td>4.78</td>
<td>10.00</td>
</tr>
<tr>
<td>4. Do you encounter problems shouting?</td>
<td>4.78</td>
<td>10.00</td>
</tr>
<tr>
<td>5. Do you have to strain to produce voice</td>
<td>6.00</td>
<td>10.00</td>
</tr>
</tbody>
</table>

Reliability of the screening questionnaire

In total, 104 respondents completed the second questionnaire (59% return rate). None of the respondents were excluded based on the two additional questions on recent voice changes. The test-retest intraclass correlation coefficients are shown in Table 4. Correlation coefficients were good to very good, varying from 0.67 to 0.76.
Table 4. Intraclass correlation coefficients (ICC) for the relationship between test and retest scores

<table>
<thead>
<tr>
<th>question</th>
<th>ICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does your voice sound deviant (e.g. breathy or rough)?</td>
<td>0.71</td>
</tr>
<tr>
<td>2. Do you encounter problems holding conversation due to your voice?</td>
<td>0.67</td>
</tr>
<tr>
<td>3. Do you encounter problems making a telephone call due to your voice?</td>
<td>0.76</td>
</tr>
<tr>
<td>4. Do you encounter problems shouting?</td>
<td>0.69</td>
</tr>
<tr>
<td>5. Do you have to strain to produce voice</td>
<td>0.69</td>
</tr>
</tbody>
</table>

Predictive validity

Patient group vs. control group
Regarding overall voice impairment (score of 5 or less on at least 1 of the 5 items), 40% of the patients vs. 9% of the controls had overall voice impairment, which difference proved to be significant \( p > 0.0005 \). The number of persons with voice impairment, based on each individual question (score of 5 or less) was significantly higher for the patient group when compared with the control group \( p \leq 0.001 \) for all five p values. An overview is given in Figure 1.

Patient group

Radiotherapy vs. laser surgery
The study was not designed to compare the two treatment modalities, particularly because baseline information was not available. Regarding overall voice impairment (score of 5 or less on at least one of the five items), 44% percent of the patients treated with radiotherapy vs. 29% of the patients treated with endoscopic laser surgery had overall voice impairment. This difference between both treatment modalities was not found to be significant \( p = 0.079 \). The number of patients with voice impairment on the separate questions showed no statistical differences between both treatment modalities \( 0.069 \leq p \geq 0.89 \) for all five p values. An overview is given in Figure 2.

Age, gender, current smoking habit, tumor stage, and posttreatment time
In the control group, no correlation was found between score per question, age, gender, and current smoking habit (Spearman correlation coefficients varied from -0.15 to -0.03).

For both treatment modalities, no correlations were found between overall voice impairment, age, tumor stage, and posttreatment time (Spearman correlation coefficients varied from -0.003 to 0.165).

Patients were not asked to fill in a question on smoking habit, because the relationship between the occurrence or recurrence of laryngeal cancer and smoking habit is well known to the patients, and they might be reluctant to answer truthfully such a question from...
Figure 1. Voice impairment (score of 5 or less) for each individual question and overall voice impairment (score of 5 or less on at least one of the five questions) for patient vs. control group. All differences are significant.

Figure 2. Voice impairment (score of 5 or less) for each individual question and overall voice impairment (score of 5 or less on at least one of the five questions) for radiotherapy vs. endoscopic laser surgery group. None of the differences are significant.
their attending physician. Furthermore, the smoking habit proved to be without con-
sequence for the questionnaire in the control group. It should be kept in mind that this
questionnaire has been developed as a screening tool and not as a sophisticated tool to
evaluate voice quality.

**DISCUSSION**

To assess health-related quality of life outcome or functional status, several specific
validated instruments are available for head-and-neck cancer patients, among which the
EORTC QLQ-H&N35\(^{41}\) (European Organization for Research and Treatment of Cancer Qual-
ity of Life Questionnaire Head and Neck Module 35 with a 3-item speech subscale), the
HNPSS\(^{42}\) (Head and Neck Performance Status Scale with a 1-item speech subscale), and
the UWQOL\(^{43}\) (University of Washington Quality of Life Head and Neck Questionnaire with
a 2-item speech sub-

scale) are most widely used. More recently, the HNHSAI\(^{44}\) (Head
and Neck Health Status Assessment Inventory with a 14-item speech subscale) and the
Voice Handicap Index have been introduced. However, for voice screening purposes,
these instruments are inappropriate either because of speech/intelligibility rather than
voice-related items (the UWQOL, the HNHSAI, and the HNPSS) or because of the length of
the questionnaire (the EORTC QLQ-H&N module with 35 items including a 3-item speech
subscale and the Voice Handicap Index with 30 items). The aim of the present study was
to assess the psychometric properties of using a 5-item screening questionnaire to detect
voice problems in daily life after treatment of early glottic cancer. The screening question-
naire can be used easily in clinical settings: The questions are simple, patients do not
need help completing the questions, completion of the questionnaire takes less than 2
min, and interpretation of the results is straightforward. Reliability, internal consistency,
and predictive validity proved to be good. Based on normative data, overall voice impair-
ment was defined as a score of 5 or less on any of the five items, which corresponds to
the common Dutch educational grading scale.

The questionnaire proved to be very useful in the differentiation between normal and
abnormal voices. In this study a relatively high number of patients report voice problems
in daily life after treatment for early glottic cancer: 44% of the patients treated with radio-
therapy reported vocal impairment vs. 29% of the patients treated with endoscopic laser
surgery. This difference is not significant.

As every experienced clinician knows, a poor voice or deterioration of voice can be the
first sign of recurrence of laryngeal cancer\(^{11,37}\). During the study period, 4 out of 5 pa-
tients with local recurrence of the tumor had impairment of the voice according to the
screening questionnaire at the time or even before this recurrence was clinically appar-
ent. Using this 5-item screening questionnaire on a routine basis can help the clinician
in the early detection of tumor recurrence. Detmar and Aaronson\textsuperscript{45} suggested that use of such questionnaires might facilitate the doctor-patient communication; some patients hesitate to “burden” their doctor with problems, whereas other patients find it difficult to elicit relevant information. The questionnaire might increase efficiency of a follow-up visit: It enables the physicians to focus quickly on issues that require further attention.

The present study supports the recommendation by the Dutch Cooperative Head and Neck Oncology Group\textsuperscript{39} to use this reliable and validated 5-item questionnaire on a regular basis after treatment of glottic cancer. If this questionnaire indicates the existence of voice impairment, a more extensive voice analysis, including acoustic measurements and laryngostroboscopy, is recommended.

CONCLUSION

The 5-item questionnaire proved to be a reliable and feasible quick method to detect voice impairment in daily life. The questionnaire is easy to fill in, and interpretation is straightforward. It is useful for both radiation oncologists and otorhinolaryngologists in their follow-up of patients treated for early glottic cancer. When used on a regular basis, the questionnaire can easily detect voice deterioration, and results of the questionnaire can help clinicians in deciding whether to perform a more extensive voice assessment protocol and medical examination.
REFERENCES


